

AMENDMENTS TO THE CLAIMS

The following listing of claims replaces all prior listings, and all prior versions, of claims in the application.

LISTING OF CLAIMS:

1. (currently amended) An ultrasonic motion detecting device, comprising:
 - an ultrasonic transducer first and second ultrasonic transducers having
piezoelectric elements arranged in an array, which transmit ultrasonic waves to an object and acquire reflection signals from the object;
 - a motion detection unit that extracts a plurality of estimation regions which are used for estimating partial motions of the object from the reflection signals that are acquired by the first and second ultrasonic transducers ultrasonic transducer, and detects a three-dimensional motion of the object within the estimation regions; and
 - an image display unit that displays the three-dimensional motion within the estimation regions,
- wherein ultrasonic wave scanning surfaces due to the first and second ultrasonic transducers ultrasonic transducer cross over each other, and
 - wherein the motion detection unit detects projected components that are detected from a plurality of first two-dimensional cross-section images of the object which are obtained from the first ultrasonic transducer and a plurality of second two-dimensional cross-section images of the object which are obtained from the second ultrasonic transducer to produce velocity components of the three-dimensional motion of the object which is positioned on an intersection line of the first and second two-dimensional cross-section images, and constructs the three-dimensional motion on the basis of the first two-dimensional cross-section image, the second two-dimensional cross-section image and the projected components.

2. (currently amended) The ultrasonic motion detecting device according to claim 1, wherein the first and second transducers alternately conduct ultrasonic transducer alternately conducts ultrasonic scanning to acquire a biplane image including two scanning surfaces which are not in parallel to each other.

3. (currently amended) The ultrasonic motion detecting device according to claim 1, wherein the first and second transducers alternately transmit and receive ultrasonic transducer alternately transmits and receives ultrasonic beams to acquire a biplane image.

4. (original) The ultrasonic motion detecting device according to claim 1, wherein the signal component used for estimating the motion comprises a contour component of the object, a speckle component occurring by allowing the reflection signals from point reflectors that are scattered within a body of the object to interfere with each other, or a combination of the contour component with the speckle component.

5. (cancelled).

6. (currently amended) The ultrasonic motion detecting device according to claim 1, wherein a correlation function of a plurality of one-dimensional signals of

the reflection signals that are acquired by the first and second ultrasonic transducers
ultrasonic transducer is conducted within the estimation regions.

7. (cancelled).

8. (original) The ultrasonic motion detecting device according to claim 1,
wherein the imaging cross-section is changed according to the motion of the object
to display the focusing image of the object on the image display unit in real time.

9. (currently amended) An ultrasonic therapeutic device that combines
therapeutic transducers a therapeutic transducer with the ultrasonic motion detecting
device according to claim 1, wherein a focal point of the therapeutic ultrasonic waves
of the ultrasonic therapeutic device focuses on the motion of the object.

10. (original) The ultrasonic therapeutic device according to claim 9,
wherein the three-dimensional motion of the object and an automatic focusing state
of the focal point of the therapeutic ultrasonic waves in correspondence with the
three-dimensional motion are displayed on the image display unit as a three-
dimensional real moving image, and the biplane images of the object is displayed on
the image display unit at the same time.

11. (withdrawn) An image producing device using the ultrasonic motion
detecting device according to claim 1, the image producing device comprising:

an imaging cross-section ascertaining unit that estimates a relative motion from an initial position of the imaging cross-section due to the first and second ultrasonic transducers according to the result of the motion that is detected by the motion detection unit to determine the positions of the imaging regions produced by the first and second ultrasonic transducers;

a three-dimensional image memory unit that stores the three-dimensional image of the object therein;

an initial cross-sectional position setting unit that sets a two-dimensional image that is extracted from the three-dimensional image which corresponds to the initial position as an initial position; and

an image extraction unit that changes the extracted cross-section which is set by the initial cross-sectional position setting unit according to a change in the imaging cross-section due to the first and second ultrasonic transducers which is ascertained by the imaging cross-section ascertaining unit to extract a corresponding two-dimensional high-resolution image from the three-dimensional image memory unit,

wherein the extracted image is displayed on the image display unit as needed.

12. (withdrawn) The image producing device according to claim 11, wherein the three-dimensional image comprises any one of an MRI image, an X-ray CT image, and a PET image.

13. (withdrawn) The image producing device according to claim 11, wherein an initial position of the imaging cross-section due to the first and second ultrasonic transducers and an initial position in the three-dimensional image in correspondence with the initial position of the image cross-section are set by using positional information on a characteristic region of the object such as xiphoid process of the sternum.

14. (withdrawn) The image producing device according to claim 11, wherein the three-dimensional image includes an image of an artificial contrast material that is attached to an interior or an exterior of the object, and an initial position of the imaging cross-section due to the first and second ultrasonic transducers and an initial position in the three-dimensional image in correspondence with the initial position of the image cross-section are set on the basis of a position of the contrast material.

15. (withdrawn) The image producing device according to claim 11, wherein an initial position of the imaging cross-section due to the first and second ultrasonic transducers and an initial position in the three-dimensional image in correspondence with the initial position of the image cross-section are set at a position where an integration value of an absolute value of a difference value between the ultrasonic image due to the first and second ultrasonic transducers and the extracted image that is extracted from the three-dimensional image becomes smallest.

16. (withdrawn) The image producing device according to claim 11, wherein a plurality of estimation regions are set to estimate the motion of the object, thereby detecting a shift and/or a deformation of an inspection region in the interior of the object.

17. (withdrawn) The image producing device according to claim 11, further comprising: an extracted image reconstruction unit that sets a plurality of estimation regions to interpolate the plurality of extracted cross-sections to continuously combine the estimation regions with each other, and reconstructs the two-dimensional extracted image.

18. (currently amended) An ultrasonic motion detecting device, comprising:

an ultrasonic transducer~~first and second ultrasonic transducers~~, which transmit~~transmits~~ ultrasonic waves to an object and acquire reflection signals from the object; and

a motion detection unit that extracts a plurality of estimation regions which are used for estimating partial motions of the object from the reflection signals that are acquired by the ~~first and second ultrasonic transducers~~ultrasonic transducer, and detects a three-dimensional motion of the object within the estimation regions;

wherein ultrasonic wave scanning surfaces due to the ~~first and second ultrasonic transducers~~ultrasonic transducer cross over each other, and

wherein the motion detection unit detects velocity components of the three-dimensional motion of the object, which is positioned on an intersection line of the

ultrasonic waves scanning surfaces, based first two-dimensional cross-section images of the object obtained from the first ultrasonic transducer in sequential frames and second two-dimensional cross-section images of the object obtained from the second ultrasonic transducer in sequential frames, and constructs the three-dimensional motion of the object to be displayed in an image display unit in accordance with the velocity components of the three-dimensional motion of the object.

19. (previously presented) The ultrasonic motion detecting device according to claim 1, wherein the motion detection unit produces the motion of the projected component with calculating a correlation function between a base frame and a next frame of sequential frames and if the motion is lower than a predetermined value, produces the motion of the projected component with calculating the correlation function between the base frame and an after next frame of the sequential frames.

20. (previously presented) The ultrasonic motion detecting device according to claim 18, wherein the motion detection unit produces the motion of the object with calculating a correlation function between a base frame and a next frame of the sequential frames, and if the motion is lower than a predetermined value, produces the motion of the object with calculating the correlation function between the base frame and an after next frame of the sequential frames.

21. (new) The ultrasonic motion detecting device according to claim 1, wherein the ultrasonic transducer is a transducer having a two dimensional array.

22. (new) The ultrasonic motion detecting device according to claim 18, wherein
the ultrasonic transducer is a transducer having a two dimensional array